# Supplementary Material

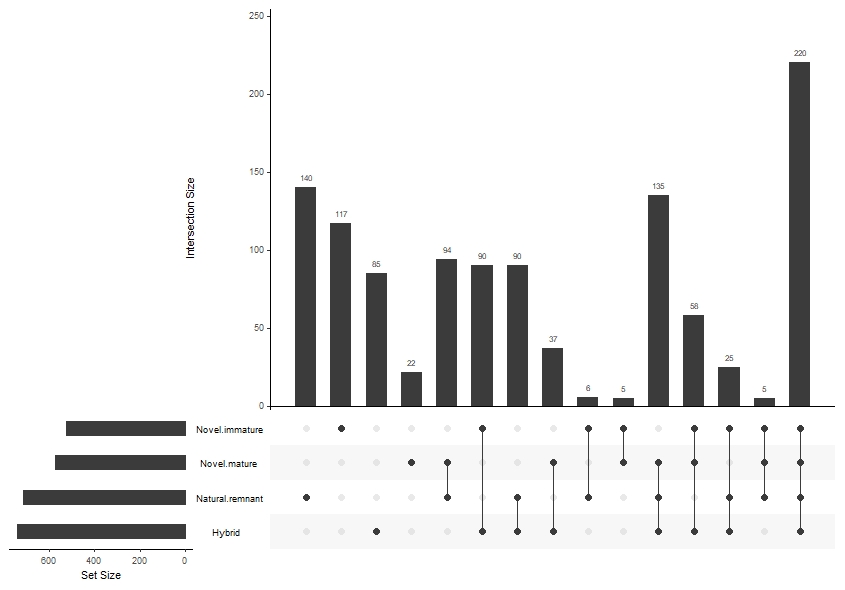
Table S1: Differentiation of four major types of ecosystems that were used as reference for expert-based assessments of the presence/absence and population status of vascular plant species in Berlin (see appendix to Kowarik 1991). These ecosystems roughly relate to natural remnants, hybrid systems, initial novel systems and mature novel systems although overlaps exist between categories (adapted from Kowarik & von der Lippe 2018).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Natural remnant ecosystems** | **Hybrid ecosystems** | **Initial novel ecosystems** | **Mature novel ecosystems** |
| **Prevalence of natural ecosystem processing** | High | Medium | Low | High |
| **Origin of sites** | Natural | Natural or anthropogenic | Natural or anthropogenic | Anthropogenic |
| **Examples of ecosystem types** | Near-natural forests, mires, wetlands, extensively used dry or wet grassland and associated succession stages | Young tree plantations in forests and parks, managed grassland, intermediate succession stages following abandonment, managed borders of water bodies | Intensively managed agricultural fields and pasture land, lawns, flower beds, initial stages of wasteland succession, habitats along roads or tracks with herbicide or salt application | Emerging forests on urban wastelands or fortifications, consolidated un-managed grass­land on old roofs and other artificial surfaces, secondary wetlands in water reservoirs or gravel pits |
| **Category labels in original dataset** | 1a | 2 | 3 | 1b |

Table S2: Traits and species attributes (“Trait”) chosen as predictors of the population establishment of vascular plant species within four types of ecosystems in Berlin, Germany. Shown are trait values with their type of variable (cat = categorical, int = integer, num = numeric), units, data sources (LEDA = Knevel et al. (2003), Kleyer et al. (2008); Ellenberg = Ellenberg (1974); BiolFlor = Klotz et al. (2002), Kühn et al. (2004)), and environmental filters the traits are related to. The percentage of missing values is given per trait. Numbers of species are given per level of a categorical trait.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Values** | **Type** | **Unit** | **Source** | **Filters** | **% Missing** | **Number of species** |
| Canopy height – maximum | - | num | m | LEDA | Survival | 13.64 |  |
| Canopy height – minimum | - | num | m | LEDA | Survival | 13.64 |  |
| Dispersal vector | By animals | cat | - | LEDA | Dispersal | 24.18 | 374 |
| By humans | 122 |
| By water | 22 |
| By wind | 60 |
| Multiple vectors | 1102 |
| Ellenberg value – continentality | 1 – 3: oceanic | cat | - | Ellenberg | Environmental | 24.18 | 666 |
| 4 – 6: oceanic to continental | 729 |
| 7 – 9: continental | 136 |
| Indifferent | 409 |
| Ellenberg value – light | 1 – 5: Deep shade to half shade | cat | - | Ellenberg | Environmental | 24.18 | 287 |
| 6 – 7: Half shade to half light (“medium”) | 812 |
| 8 – 9: Half light to full sunlight | 617 |
| Indifferent | 222 |
| Ellenberg values – Nitrogen | 1 – 3: Low nitrogen concentration | cat | - | Ellenberg | Environmental | 24.18 | 499 |
| 4 – 6: Medium nitrogen concentration | 636 |
| 7 – 9: High nitrogen concentration | 443 |
| Indifferent | 362 |
| Ellenberg values – Moisture | 1 – 3: Dry | cat | - | Ellenberg | Environmental | 24.18 | 287 |
| 4 – 6: Fresh | 1003 |
| 7 – 12: Moist & Wet | 320 |
| Indifferent | 328 |
| Ellenberg values – Reaction | 1 – 3: Acid | cat | - | Ellenberg | Environmental | 24.18 | 130 |
| 4 – 6: Neutral | 347 |
| 7 – 9: Alkaline | 843 |
| Indifferent | 620 |
| Ellenberg values – Temperature | 3 – 5: Cool | cat | - | Ellenberg | Environmental | 24.18 | 349 |
| 6: Medium | 787 |
| 7 – 8: Warm to hot | 234 |
| Indifferent | 568 |
| Flowering phenology – beginning of flowering | 1 – 10 according to months January to October | int | - | BiolFlor | Reproduction | 0.08 |  |
| Flowering phenology – duration of flowering | 1 – 12 according to number of months a species can flower | int | - | BiolFlor | Reproduction | 0.08 |  |
| Flowering phenology – end of flowering | 3 – 12 according to months March to December | int | - | BiolFlor | Reproduction | 0.08 |  |
| Life span | Annual | cat | - | BiolFlor | Survival | 0.00 | 485 |
| Biennial | 72 |
| Perennial | 1744 |
| Multiple life span types possible | 258 |
| Pollination vector | Insects | cat | - | BiolFlor | Reproduction | 2.65 | 671 |
| Selfing | 98 |
| Wind | 446 |
| Multiple pollination vectors | 1283 |
| Seed mass - mean | - | num | mg | LEDA | Dispersal, Reproduction | 18.16 |  |
| Type of reproduction | Clonal | cat | - | BiolFlor | Reproduction | 0.00 | 149 |
| By seeds | 1418 |
| Clonal and by seeds | 992 |

Fig. S1: Number of species (vertical bars) present in four types of ecosystems (horizontal bars) within the city of Berlin, Germany. From left to right, the first four vertical bars show the number of species exclusively present in one of the ecosystem types, the fifth to tenth vertical bars show the number of species present in two ecosystem types, the eleventh to fourteenth vertical bars show the number of species present in three ecosystem types, and the last vertical bar shows the number of species present in all four ecosystem types. The figure was created using function ‘upset’ within R-package ‘UpSetR’ (Gehlenborg 2019).



**References in Supplementary Material**

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Gehlenborg, N. (2019). UpSetR: A More Scalable Alternative to Venn and Euler Diagrams for Visualizing Intersecting Sets. R package version 1.4.0. <https://CRAN.R-project.org/package=UpSetR>

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